

GAO

Report to the Subcommittee on Antitrust,
Competition Policy and Consumer
Rights, Committee on the Judiciary,
U.S. Senate

April 2005

TELECOMMUNICATIONS

Direct Broadcast Satellite Subscribership Has Grown Rapidly, but Varies across Different Types of Markets



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Highlights

Highlights of [GAO-05-257](#), a report to the Subcommittee on Antitrust, Competition Policy and Consumer Rights, Committee on the Judiciary, U.S. Senate

Why GAO Did This Study

Since its introduction in 1994, direct broadcast satellite (DBS) service has grown dramatically, and this service is now the principal competitor to cable television service. Although DBS service has traditionally been a rural service, passage of the Satellite Home Viewer Improvement Act of 1999 enhanced the competitiveness of DBS service in suburban and urban markets. GAO agreed to examine (1) how DBS subscribership changed since 2001; (2) how DBS penetration rates differ across urban, suburban, and rural areas; (3) how DBS penetration rates differ across markets based on the degree and type of competition provided by cable operators; and (4) the factors that appear to influence DBS penetration rates across cable franchise areas.

To complete this report, GAO prepared descriptive statistics and an econometric model using data from the Federal Communications Commission's annual Cable Price Survey and the Satellite Broadcasting and Communications Association's subscriber count database.

www.gao.gov/cgi-bin/getrpt?GAO-05-257.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Mark L. Goldstein at (202) 512-2834 or goldsteinm@gao.gov.

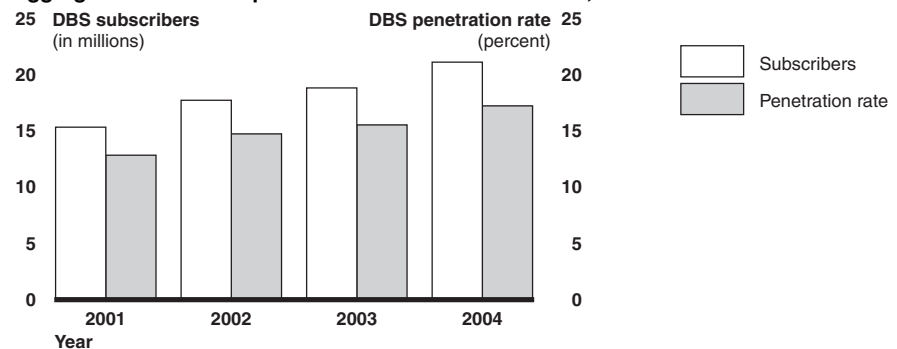
TELECOMMUNICATIONS

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What GAO Found

Since 2001, the number of households subscribing to DBS service has grown rapidly; thus the percentage of households subscribing to DBS service, the DBS penetration rate, has grown to over 17 percent of American households.

Aggregate DBS Subscription and DBS Penetration Rates, 2001-2004



Source: GAO.

The DBS penetration rate is highest in rural areas, but growing most rapidly in suburban and urban areas. Between 2001 and 2004, the DBS penetration rate grew 15 percent in rural areas to 29 percent of rural households, 32 percent in suburban areas to 18 percent of suburban households, and 50 percent in urban areas to 13 percent of urban households.

The degree and type of competition influences the DBS penetration rate. In areas with no cable service, the DBS penetration rate is about 53 percentage points greater than in areas where cable service is available. Where cable service is available, cable operators increasingly offer advanced services. The DBS penetration rate is approximately 20 percentage points greater in areas where cable operators are not providing advanced services, compared with areas where these services are available. While relatively few areas have more than one wire-based cable operator, in these areas the DBS penetration rate is 8 percentage points lower than in areas with only one cable operator.

In addition to the differences in DBS penetration rates across rural, suburban, and urban areas, and differences associated with the degree and type of cable competition, additional geographic and competitive factors also influence the DBS penetration rate. For example, the DBS penetration rate is lower in areas with a high prevalence of multiple-dwelling units, such as apartments. Additionally, the DBS penetration rate is higher in areas where DBS providers offer local broadcast stations (such as ABC and NBC affiliates) directly to their subscribers.

The Federal Communications Commission provided technical comments on a draft of this report that we incorporated where appropriate.

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Abbreviations

2SLS	two stage least squares
3SLS	three stage least squares
BLS	Bureau of Labor Statistics
CUID	Community Unit Identification
DBS	direct broadcast satellite
DMA	designed market area
FCC	Federal Communications Commission
MSA	metropolitan statistical area
MSO	multiple system operator
SBCA	Satellite Broadcasting and Communications Association

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United States Government Accountability Office
Washington, D.C. 20548

April 6, 2005

The Honorable Mike DeWine
Chairman
The Honorable Herb Kohl
Ranking Minority Member
Subcommittee on Antitrust, Competition
Policy and Consumer Rights
Committee on the Judiciary
United States Senate

For many years, cable television operators faced little competition in the market for subscription video service. However, in 1994, a new type of competitor emerged: direct broadcast satellite (DBS). Subscribers to DBS service use small reception dishes to receive television programming beamed down from satellites that orbit over the equator. DBS was originally most popular in rural areas, where cable service was often limited or did not exist. In recent years, DBS has also become popular in suburban and urban markets. In particular, the competitiveness of DBS was bolstered when the Congress enacted the Satellite Home Viewer Improvement Act of 1999, which allows DBS carriers to provide local broadcast signals, such as the affiliates of ABC and NBC, directly to subscribers.¹ Today, the two primary DBS providers—DIRECTV[®] and EchoStar—provide local broadcast signals in 156 of 210 television markets.

You asked us to provide information on the extent to which DBS is competitive with cable under varied market circumstances. Specifically, this report provides information on (1) how DBS subscribership has changed since 2001; (2) how DBS penetration rates (that is, the percentage of households subscribing to DBS) differ across urban, suburban, and rural areas; (3) how DBS penetration rates differ across markets based on the degree and type of competition provided by cable operators; and (4) the

¹In late 2004, the Congress passed and the President signed the Satellite Home Viewer Extension and Reauthorization Act of 2004. This act may further enhance the competitiveness of DBS providers by, for example, permitting DBS providers to deliver broadcast signals that are “significantly viewed” within a local market but originate from outside that local market.

factors that appear to influence DBS penetration rates across cable franchise areas.²

To respond to the objectives of this report, we gathered data on DBS subscribers from the Satellite Broadcasting and Communications Association (SBCA)³ and cable rates and services from the Federal Communications Commission (FCC). For the first and second objectives, we calculated the DBS penetration rate at the county level for the years 2001 to 2004. This allowed us to examine the trend in the DBS penetration rate for that period of time. We also classified counties as urban, suburban, and rural, based on the location of central cities and designations of metropolitan statistical areas (MSA), and calculated the DBS penetration rate for each of these geographic categories. For the third objective, we used data from Knowledge Network's 2004 *The Home Technology Monitor*⁴ survey to identify responding households that said cable service was not available to them, and to then examine the penetration of DBS service among these responding households, compared with those who said that cable service was available in their area. We also calculated the DBS penetration rate for cable franchise areas included in FCC's 2002 and 2004 Cable Price surveys.⁵ Using data from FCC's surveys, we classified each cable franchise on the basis of (1) whether "advanced services"—such as cable modem and digital cable tiers of programming—were provided by cable operator and (2) whether there was a second wire-based provider in the market. We then calculated the DBS penetration rate for these different categories of cable franchise areas. For the fourth objective, we used an econometric model we previously developed that examines the competitive interaction of cable and DBS providers. Using data from 2004, the model considers the effect of various factors (such as the number of channels provided by the cable company) on cable rates, the number of cable subscribers, the number of channels that cable operators provide to

²At the community level, cable operators obtain a franchise agreement under agreed-upon terms and conditions from a franchising authority, such as a city, township, or county. The franchise agreement permits the cable operator to provide service in the jurisdiction.

³SBCA is a national trade association representing the satellite industry. Its members include DBS, C-band, satellite radio, and other satellite service providers, among others.

⁴Knowledge Networks is a survey research firm that had conducted a consumer survey on household television characteristics. The survey provided the responses of 2,471 randomly selected American households.

⁵FCC conducts an annual survey of a random sample of cable franchise areas to gather information about cable pricing and other related issues.

subscribers, and the DBS penetration rate in areas throughout the United States.⁶ See appendix I for additional information on our scope and methodology and appendix II for the steps we took to ensure the reliability of the data we used to prepare this report. We found these data to be sufficiently reliable for the purposes of this report.

We conducted our review from March 2004 to February 2005 in accordance with generally accepted government auditing standards.

Results in Brief

Subscriptions to DBS service have grown rapidly since 2001. In July 2001, about 15.5 million American households—about 13 percent of households—subscribed to a DBS service. By January 2004, about 21.3 million households subscribed to a DBS service, or 17.4 percent of households. Thus, the number of DBS subscribers increased by 37.8 percent during this 2-1/2 year time frame.⁷

DBS penetration rates have been and remain highest in rural areas, but since 2001, DBS penetration has grown most rapidly in urban and suburban areas, where the penetration rates were originally low. In 2001, DBS penetration rates were nearly 26 percent in rural areas, 14 percent in suburban areas, and about 9 percent in urban areas. By 2004, DBS penetration rates had increased to about 29 percent in rural areas, 18 percent in suburban areas, and 13 percent in urban areas, indicating a consistent pattern of higher DBS penetration rates in rural areas. In short, over the 2001 to 2004 time frame, the DBS penetration rate grew about 50 percent and 32 percent in urban and suburban areas, respectively, compared with a growth rate of 15 percent in rural areas.

DBS penetration rates are affected by the degree and type of competition in a local market. Based on survey data, we found that relatively few

⁶This four equation model is an adaptation of a model that GAO developed and discussed in three previous reports. See GAO, *Telecommunications: The Effect of Competition from Satellite Providers on Cable Rates*, [RCED-00-164](#) (Washington, D.C.: July 18, 2000); *Telecommunications: Issues in Providing Cable and Satellite Television Services*, [GAO-03-130](#) (Washington, D.C.: Oct. 15, 2002); and *Telecommunications: Issues Related to Competition and Subscriber Rates in the Cable Television Industry*, [GAO-04-8](#) (Washington, D.C.: Oct. 24, 2003).

⁷The data cover 2-1/2 years, rather than 3 years, because FCC changed the time frame of its survey from July to January in 2004.

American households—less than 9 percent—do not have the opportunity to purchase cable television service because it is not available where they live.⁸ However, in these areas, the DBS penetration rate is about 53 percentage points greater than it is in areas where cable television service is available. In areas where cable television service is available, cable operators are increasingly providing advanced services, such as digital cable, cable modem, and telephone service. In 2004, the DBS penetration rate was approximately 20 percentage points greater in areas where cable operators were *not* providing advanced services, compared with areas where these services were available. Finally, in most areas, cable companies do not compete with other wire-based competitors, but in limited areas there is more than one wire-based provider of cable television service. Where more than one cable provider exists, the DBS penetration rate is 8 percentage points lower than in areas with only one cable provider.

Using an econometric model to control for the many factors that influence the DBS penetration rate, we identified three key geographic factors and three key competitive factors that influence the DBS penetration rate. Some of these findings confirm the findings discussed above based on descriptive statistics, and other findings could only be examined within the model. Regarding the geographic factors, we found that (1) the DBS penetration rate is lower in markets with a high prevalence of multiple dwelling units, such as apartments and condominiums; (2) the DBS penetration rate is lower in areas where, in order to face the transmitting satellite, the satellite dish must be installed at a relatively low angle, facing the horizon more than the sky; and (3) the DBS penetration rate is higher in nonmetropolitan areas. Regarding the competitive factors, we found that (1) the DBS penetration rate is lower in areas where the cable operator's system has greater system capacity;⁹ (2) the DBS penetration rate is lower in areas where there is more than one wire-based cable provider; and (3) the DBS penetration rate is higher in areas where DBS providers carry local broadcast stations, such as an ABC affiliate.

⁸The percentage of households with cable service available has been a subject of controversy. Different industry participants, using different data sources and different bases of comparison, arrive at different figures. Using industry data, FCC noted that the percentage of homes with a television passed by cable must be *less than* 97.8 percent. Alternatively, the National Rural Telecommunications Cooperative reports that 22.4 million households (or about 20 percent) lack access to cable service. We used a survey of a random sample of households to arrive at the 9 percent figure.

⁹System capacity is measured in terms of the system megahertz. Systems with larger capacity are able to provide more channels and other services to their subscribers.

We provided a draft of this report to the Federal Communications Commission (FCC) for their review and comment. FCC staff provided technical comments that we incorporated where appropriate.

Background

Cable television service emerged in the late 1940s to fill a need for television service in areas with poor over-the-air reception, such as mountainous or remote areas. At that time, cable operators simply retransmitted the signals of local broadcast stations. By the late 1970s, cable operators began to provide new cable networks,¹⁰ such as HBO, Showtime, and ESPN, and the number of cable subscribers increased rapidly. Two significant changes occurred in the 1990s and early 2000s. First, the Congress passed the Cable Television Consumer Protection and Competition Act of 1992 that, among other things, prohibited local franchising authorities from awarding exclusive (or monopoly) franchises to cable operators, thereby opening the door to wire-based competition. Second, cable operators began offering new services, such as digital cable, cable modem Internet access, and telephone, in addition to their basic video service. Today, many cable operators offer these advanced services in bundles with their basic video service.

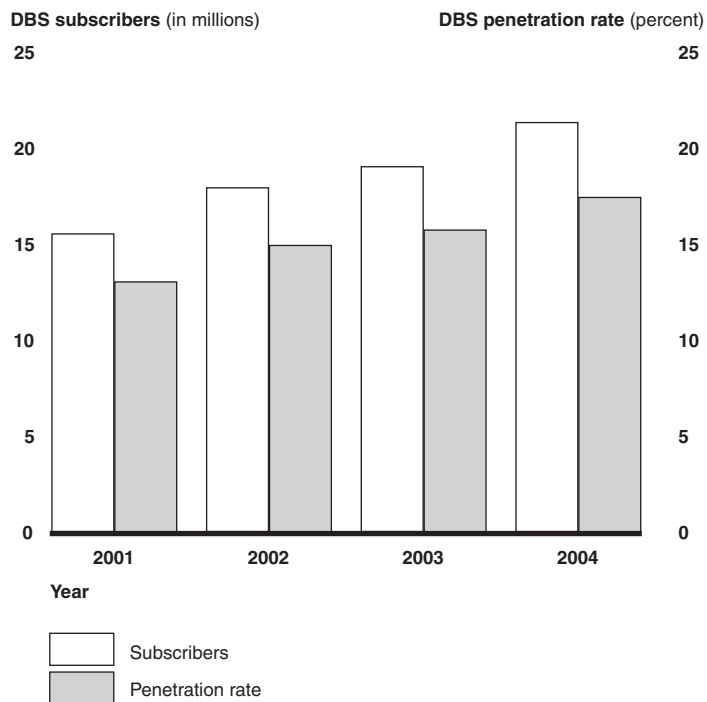
Since its introduction in 1994, direct broadcast satellite (DBS) service has grown dramatically and is now the primary competitor to cable operators. Subscribers to DBS service use a small reception dish to receive signals beamed down from satellites. Because DBS satellites orbit above the equator, a reception dish must point toward the southern sky, and households located in the northern part of the United States need to angle the dish more toward the horizon than households in the southern part of the United States. Unlike cable, which upgraded to digital service in recent years, DBS service has been a digital-based service since its inception. DBS providers generally offer most of the same cable networks as cable operators. However, for many years DBS providers did not offer local broadcast stations to their subscribers in most instances because of copyright obstacles, obstacles that cable operators did not face. After the Congress passed the Satellite Home Viewer Improvement Act of 1999, which altered the copyright rules that applied to DBS providers, cable and DBS companies were placed on a more equal competitive footing.

¹⁰Today, a variety of subscription video providers, in addition to cable operators, deliver these networks to their subscribers. For consistency, we refer to these networks as cable networks.

Subscription to DBS Has Grown Rapidly Since 2001

From 2001 to 2004, the aggregate number of U.S. households that subscribe to DBS television service grew rapidly. Figure 1 illustrates the growth in total DBS subscription and penetration rates for 2001 through 2004. In July 2001, about 15.5 million households were served by DBS. By January 2004, about 21.3 million households were served by DBS—an increase of 37.8 percent in 2-1/2 years. Similarly, over the same period of time, the overall penetration rate of DBS rose from 13 percent in 2001 to 17.4 percent in 2004—a 33.5 percent increase.

Figure 1: Aggregate DBS Subscription and DBS Penetration Rates, 2001—2004

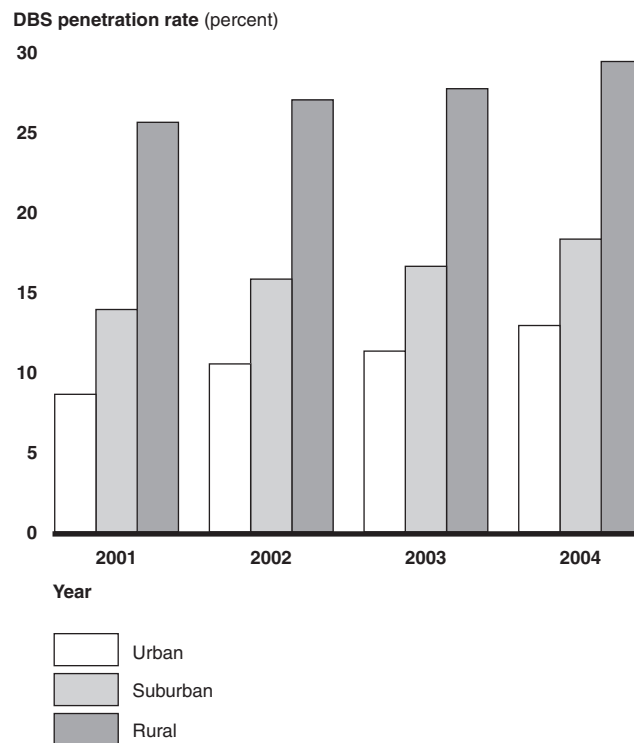


Source: GAO.

DBS Has the Greatest Penetration in Rural Areas, but Subscriber Growth Has Been Greater in Urban and Suburban Areas Since 2001

DBS penetration rates have been higher in rural areas than in suburban and urban areas throughout the last several years, as shown in figure 2. From July 2001 to January 2004, DBS penetration has grown steadily in all three types of geographic areas. In 2001, penetration rates were highest in rural areas at 25.6 percent, followed by 13.9 percent in suburban areas and 8.6 percent in urban areas. As of January 2004, DBS penetration remained the highest in rural areas, growing to about 29 percent, while it grew to 18 percent of suburban households and 13 percent of urban households.

Figure 2: DBS Penetration Rates in Urban, Suburban, and Rural Areas, 2001—2004

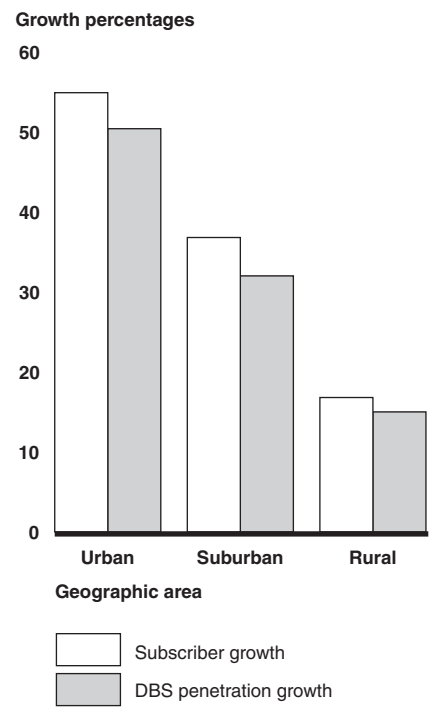


Source: GAO.

Although the DBS penetration rate in rural areas has been and remains higher than it is in other geographic areas, subscribership has grown more rapidly in suburban and urban areas than in rural areas from 2001 to 2004. In fact, urban areas have experienced the highest growth in overall DBS subscribership. Figure 3 displays the percentage growth in total DBS subscribers and the percentage growth in DBS penetration rates in urban,

suburban, and rural areas. From 2001 to 2004, DBS subscribership grew 55 percent in urban areas, 37 percent in suburban areas, and 17 percent in rural areas. In the same time period, the growth in penetration rates was also highest in urban areas, at 50.4 percent, followed by suburban penetration growth at 32 percent, and rural penetration growth of 15 percent.

Figure 3: Growth in DBS Subscribers and DBS Penetration Rates, 2001—2004



Source: GAO.

DBS Penetration Is Higher Where Cable Service Is Not Available, Where Cable Providers Do Not Offer Advanced Services, and Where Wire-Based Competitors Are Not Present

Less than 9 percent of American households do not have the opportunity to purchase cable television service because it is not available where they live. However, in these areas, the DBS penetration rate is about 53 percentage points greater than in areas where cable television service is available. Where cable television service is available, cable operators are increasingly providing advanced services, such as digital cable, cable modem, and telephone service. In 2004, the DBS penetration rate was over 20 percentage points greater in areas where cable operators did not provide advanced services, compared with areas where these services were available. Finally, in some limited areas, cable companies compete with other wire-based competitors, and where there is more than one wire-based cable competitor, the DBS penetration rate was 8 percentage points lower than in areas without such an additional competitor.

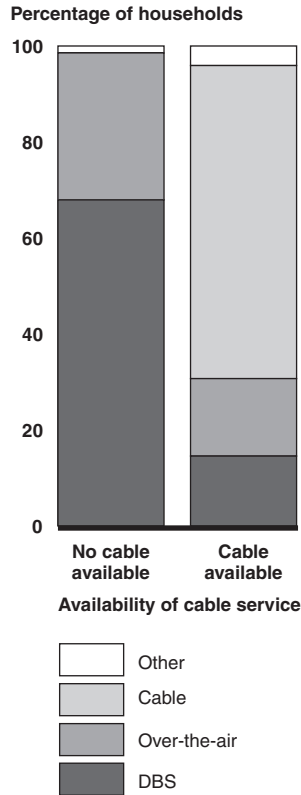
DBS Penetration Is Much Higher in Areas without Cable Service

Most households in the United States have access to cable television service. Using Knowledge Network's 2004 survey, we found that less than 9 percent of responding households reported that cable television service was not available. According to FCC, households without access to cable television service generally reside in smaller and rural markets.¹¹

Where cable television service is not available, households are far more likely to purchase DBS service. In figure 4, we illustrate the percentage of households receiving television service through four different modes (over-the-air, cable, DBS, and other) for areas where households report that cable television service is available and where it is not available. In areas where cable television service is available, 65 percent purchase cable service, 16 percent use free over-the-air television, and about 15 percent purchase DBS service. When cable television service is not available, a significant percentage of households—nearly 68 percent—purchase DBS service, while nearly all of the remainder—31 percent—rely on over-the-air television.

¹¹Federal Communications Commission, *Tenth Annual Report, In the Matter of: Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming*, FCC-04-5 (Washington, D.C.; Jan. 28, 2004), para. 21.

Figure 4: Percentage of Households Using Different Modes of Television Reception, 2004



Source: GAO analysis of Knowledge Network's 2004 *The Home Technology Monitor* survey.

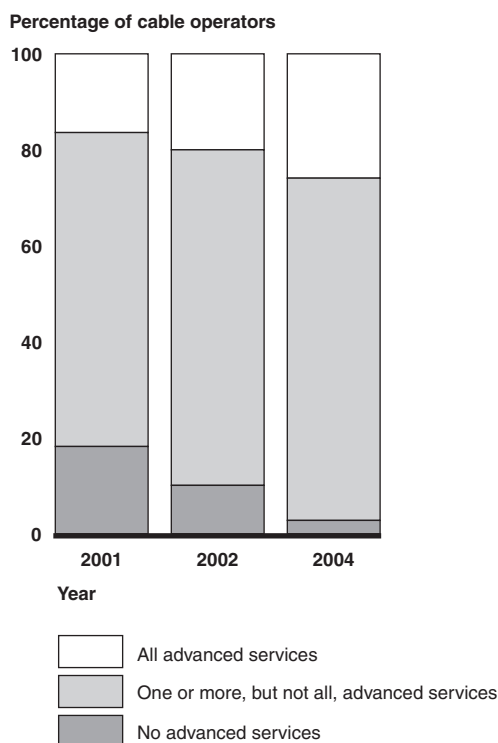
DBS Penetration Is Much Higher in Areas Where Cable Operators Do Not Offer Advanced Services

Since 2001, the percentage of cable operators providing advanced services (digital cable, cable modem, and telephone services) has increased. In figure 5, we illustrate the percentage of cable operators providing no advanced services; one or more, but not all, advanced services; and all three advanced services based on FCC's annual survey of cable franchises.¹² In 2001, over 18 percent of cable operators did not provide advanced services, while less than 3 percent did not provide advanced services by 2004. At the same time, the percentage of cable operators

¹²Federal Communications Commission, *Order, In the Matter of: Statistical Report on Average Rates for Basic Service, Cable Programming Services and Equipment*, [DA 04-35](#) (Washington, D.C.; Jan. 14, 2004), and [DA 02-1285](#) (Washington, D.C.; May 31, 2002).

providing all three advanced services increased from 16 percent in 2001 to 26 percent in 2004. In 2004, most cable operators (about 66 percent) provided both digital cable and cable modem services, but not telephone service.

Figure 5: Percentage of Cable Operators Providing Advanced Services (Digital Cable, Cable Modem, and Telephone), 2001—2004

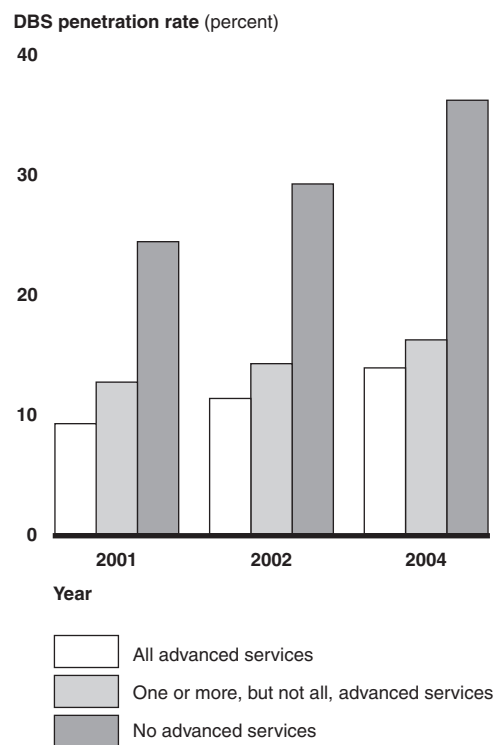


Sources: FCC 2002 and 2004 surveys.

In areas where cable operators do not provide advanced services, the DBS penetration rate is significantly greater than in areas where cable operators provide advanced services. In figure 6, we illustrate the DBS penetration rate for 2001, 2002, and 2004 based on the availability of advanced services from cable operators. In 2004, the DBS penetration rate was over 36 percent in areas where cable operators did not provide advanced services, compared with approximately 16 percent in areas where cable operators provided one or more, but not all, advanced services, and only 14 percent in areas where cable operators provided all three advanced services. In fact, the DBS penetration rate increased modestly since 2001 in areas where

cable operators provide one or more advanced services. However, the DBS penetration rate increased 12 percentage points since 2001 in areas where cable operators do not provide advanced services.

Figure 6: DBS Penetration Rate and Cable Operators' Provision of Advanced Services (Digital Cable, Cable Modem, and Telephone), 2001—2004



Sources: FCC and SBCA.

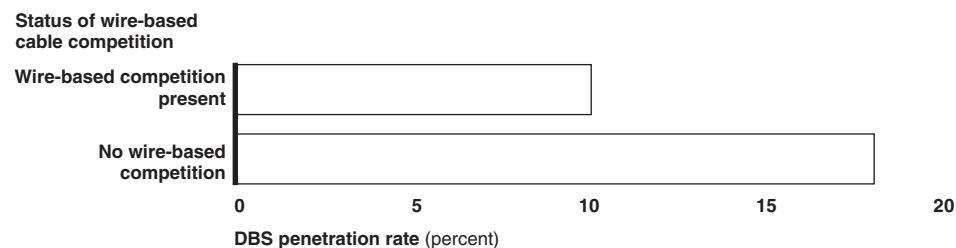
DBS Penetration Is Lower in Areas Where There Is Wire-Based Cable Competition

Although the Telecommunications Act of 1996 sought to increase wire-based competition, few American households have a choice among companies providing television service via wire-based facilities. In a 2005 report, FCC noted that few franchise areas—about 1 percent—have

effective competition based on the presence of a wire-based competitor.¹³ These competitors include telephone companies, electric and gas utilities, and broadband service providers.

In areas with more than one wire-based cable provider, the DBS penetration rate is lower compared with areas with only one wire-based provider. In figure 7, we illustrate the DBS penetration rate for 2004 in cable franchise areas with and without wire-based cable competition. The DBS penetration rate is 18 percent in areas without wire-based competition and 10 percent in areas with wire-based competition.

Figure 7: DBS Penetration Rate in Cable Franchise Areas with and without Wire-Based Cable Competition, 2004



Sources: FCC and SBCA.

Several Geographic and Competitive Factors Are Associated with Different Levels of DBS Penetration across Cable Franchise Areas

We found that three key geographic factors and three key competitive factors influence DBS penetration rates in cable franchise areas throughout the United States. Regarding geographic factors, we found that (1) the DBS penetration rate is lower in areas with a high prevalence of multiple dwelling units, such as apartments and condominiums; (2) the DBS penetration rate is lower in areas where the angle at which the satellite dish must be installed is relatively low, such that the satellite points more toward the horizon than toward the sky; and (3) the DBS penetration rate is higher in nonmetropolitan areas. In terms of competitive factors, we found that (1) the DBS penetration rate is lower in areas where the cable operator's system has greater system capacity; (2) the DBS penetration rate is lower in areas where there is more than one wire-based cable provider;

¹³Federal Communications Commission, *Eleventh Annual Report, In the Matter of: Annual Assessment of the Status of Competition in the Market for the Delivery of Video Programming*, FCC-05-13 (Washington, D.C.; Feb. 4, 2005), para. 136.

and (3) the DBS penetration rate is higher in areas where DBS providers carry local broadcast stations, such as an ABC affiliate.

Key Geographic Factors Influence DBS Penetration Rates

Using an econometric model to control for the many factors that influence the DBS penetration rate, we identified three geographic factors that influenced the DBS penetration rate in cable franchise areas in 2004; see appendix III for a full explanation of, and results from, our econometric model.

- The DBS penetration rate is lower in areas with a relatively large number of housing units represented by multiple dwelling units (such as apartments and condominiums). A 10 percent increase in the percentage of housing units represented by multiple dwelling units is associated with a 2.5 percent decrease in the DBS penetration rate. One possible explanation for this result is that residents of multiple dwelling units are more likely to encounter greater difficulty installing a DBS satellite dish, since the dish requires a clear line of sight to the southern sky.¹⁴
- The DBS penetration rate is lower in areas where, to see the southern sky, the satellite dish must be pointed more toward the horizon than up at the sky. In general, the farther north one is within the United States, the more the dish must be angled toward the horizon to see the satellite over the equator. We found that a 1 percent decrease in the angle at which the DBS satellite dish must be set at is associated with a 1 percent decrease in the DBS penetration rate. A possible explanation for this result is that a satellite dish facing the horizon is less likely to have a clear line of sight to the southern sky because of interference from surrounding buildings or trees.
- The DBS penetration rate is generally higher in nonmetropolitan areas. The DBS penetration rate is about 41 percent greater in cable franchise areas outside metropolitan areas compared with cable franchise areas within metropolitan areas. This result is consistent with the results discussed above for 2001 to 2004 and may be attributed to the early popularity of satellite service in rural areas.

¹⁴To mitigate this problem, DBS providers could negotiate with MDU owners to install a single satellite dish on the roof of MDU buildings and subsequently relay the signal to residents via internal wiring.

Key Competitive Factors Influence DBS Penetration Rates

Using the same econometric model, we also identified three competitive factors that influence the DBS penetration rate in cable franchise areas in 2004.

- The DBS penetration rate is lower in areas where the cable operator's system has greater capacity. A 10 percent increase in the cable operator's system capacity is associated with a 2.4 percent decrease in the DBS penetration rate. With greater system capacity, a cable operator can provide more channels and advanced services, such as digital cable, cable modem, and telephone services. Thus, greater system capacity allows the cable operator to provide a compelling alternative to DBS service that can contribute to lower DBS penetration rates. This result is consistent with the lower DBS penetration rate in areas where cable operators provided advanced cable services for 2001 to 2004 that we discussed above.
- The DBS penetration rate is lower in areas with wire-based cable competition, compared with areas without wire-based competition. In particular, we found that DBS penetration rates are about 37 percent lower in areas with wire-based cable competition compared with areas without wire-based competition. Again, this result is consistent with the results discussed above. With wire-based competition, additional companies are competing for customers. The addition of a second cable operator can attract some customers who might otherwise have purchased DBS service, thereby reducing the DBS penetration rate.
- The DBS penetration rate is higher in areas where DBS customers can receive local-into-local service. Local-into-local service allows DBS subscribers to receive the local broadcast stations in their area (e.g., the ABC, CBS, Fox, and NBC affiliates) from the DBS provider, just as cable subscribers receive local broadcast stations from their cable operator. Since individual programming appearing on broadcast stations generally has higher ratings than individual programming appearing on cable channels, the ability of DBS providers to offer local broadcast stations to their customers remains an important competitive factor. We found that where local-into-local service is available, the DBS penetration rate is about 12 percent higher than areas where local-into-local is not available.

Agency Comments and Our Evaluation

We provided a draft of this report to the Federal Communications Commission (FCC) for its review and comment. FCC staff provided technical comments that we incorporated, where appropriate.

Industry Participants' Comments

We provided a draft of this report to the National Cable and Telecommunications Association (NCTA) and the Satellite Broadcasting and Communications Association (SBCA) for their review and comment. NCTA provided no comments. SBCA officials noted that, in addition to the factors we discuss in the report, the inability of DBS providers to carry certain programming developed by cable operators also influences the DBS penetration rate in certain markets. In particular, SBCA noted that FCC's program access rules require that vertically integrated cable operators make satellite-delivered programming available to competing subscription video providers, such as DBS providers, but that the program access rules do not apply to terrestrially delivered programming. SBCA officials note that the ability of cable operators to deliver programming terrestrially, especially popular programming such as regional sports networks, and therefore deny DBS providers access to this programming, negatively affects the DBS penetration rate in certain markets.

As agreed with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 15 days after the date of this letter. At that time, we will send copies to interested congressional committees; the Chairman, FCC; and other interested parties. We will also make copies available to others upon request. In addition, this report will be available at no cost on the GAO Web site at <http://www.gao.gov>. If you or your staff have any questions concerning this report, please contact me at (202) 512-2834 or at goldsteinm@gao.gov.

Major contributors to this report include Amy Abramowitz, Stephen Brown, Michael Clements, Simon Galed, and Bert Japikse.

A handwritten signature in black ink, appearing to read 'Mark L. Goldstein', with a long horizontal flourish extending to the right.

Mark L. Goldstein
Director, Physical Infrastructure Issues

Scope and Methodology

To respond to the first and second objectives—to provide information on how direct broadcast satellite (DBS) subscribership has changed since 2001 and how the DBS penetration rate differs across urban, suburban, and rural areas—we gathered data on DBS subscribers from the Satellite Broadcasting and Communications Association (SBCA). SBCA provided us with the number of DBS subscribers by ZIP Code^{™ 1} for the two DBS providers, DIRECTV[®] and EchoStar. Using information from the Census Bureau and a private vendor, we matched the zip codes to counties and calculated the number of DBS subscribers in each county throughout the United States. We also gathered data on housing unit projections from the Census Bureau, which, when combined with the number of DBS subscribers, allowed us to calculate the DBS penetration rate by county for July 2001 to January 2004. This allowed us to examine changes in the DBS penetration rate for that period of time. Further, using data from the Office of Management and Budget, we classified counties as urban, suburban, and rural, based on the location of central cities and designations of metropolitan statistical areas (MSA). This allowed us to calculate the DBS penetration rate for each of these geographic categories.

To respond to the third objective—to provide information on the DBS penetration rate based on the degree and type of competition—we used two different methodologies. First, to examine the DBS penetration rate in areas with and without cable service, we used survey data from Knowledge Network's *The Home Technology Monitor: Spring 2004 Ownership and Trend Report*. Knowledge Networks is a survey research firm that conducted a consumer survey on household television characteristics. Knowledge Networks interviewed 2,471 randomly sampled telephone households, asking questions regarding the household's ownership of television equipment and use of television service; see appendix II for a discussion of the steps we took to evaluate the reliability of Knowledge Network's data. The survey included questions regarding whether the household had cable service available and which method the household used to receive television (e.g., over-the-air, cable, or DBS). We used these data to identify the percentage of households receiving DBS service in areas with and without cable service. Second, to examine the DBS penetration rate in areas with advanced cable services and wire-based cable competition, we used data from FCC's annual Cable Price Survey. We used data from FCC's 2002 and 2004 surveys, which included questions

¹ZIP Code[™] is a registered trademark of the United States Postal Service. For simplicity, we refer these as zip codes.

regarding the availability of digital cable, cable modem, and telephone service and the presence of wire-based competition. We matched individual zip codes to the cable franchise areas that formed the unit of analysis in FCC's survey. When combined with the count of DBS subscribers by zip code from SBCA, we calculated the DBS penetration rate for each cable franchise area in FCC's survey. We used these data, combined with cable operators' responses to FCC's survey regarding advanced services and wire-based competition, to calculate the DBS penetration rate under these various scenarios.

To respond to the fourth objective—to provide information on the factors that appear to influence the DBS penetration rate in cable franchise areas—we used an econometric model we previously developed that examines the effect of competition on cable rates and service and the DBS penetration rate.² Using data from FCC's 2004 Cable Price Survey, the model considered the effect of various factors on cable rates, the number of cable subscribers, the number of channels that cable operators provide to subscribers, and the DBS penetration rate for areas throughout the United States. See appendix III for a more detailed explanation of, and results from, our econometric model.

²See, GAO, *Telecommunications: Issues Related to Competition and Subscriber Rates in the Cable Television Industry*, [GAO-04-8](#) (Washington, D.C.: Oct. 24, 2004); *Telecommunications: Issues in Providing Cable and Satellite Television Services*, [GAO-03-130](#) (Washington, D.C.: Oct. 15, 2002); and *Telecommunications: The Effect of Competition from Satellite Providers on Cable Rates*, [GAO/RCED-00-164](#) (Washington, D.C.: July 18, 2000).

Data Reliability

To respond to the objectives of this report, we relied extensively on three data sets and took steps to ensure the reliability of these data. The data sets we relied on include the Federal Communications Commission's (FCC) 2002 and 2004 Cable Price surveys, direct broadcast satellite (DBS) subscriber counts by zip code from the Satellite Broadcasting and Communications Association (SBCA), and Knowledge Network's 2004 *The Home Technology Monitor* survey. In this appendix, we explain the steps we took to ensure that these data were sufficiently reliable for the purposes of our work.

FCC's Cable Price surveys

FCC annually surveys approximately 700 cable franchises to fulfill a congressional mandate to report on average cable rates for cable operators found to be subject to "effective competition"—a legally defined term—compared with operators not subject to effective competition. In previous testimonies and a report, we have noted weaknesses with FCC's survey, including insufficient instructions and inaccuracies in the classification of the competitive status of cable operators.¹ In response to our recommendations, FCC has taken several steps to improve the reliability of its survey, including editing the survey document and correcting inaccurate classifications of the competitive status of cable franchises. Additionally, FCC conducts follow-ups with survey respondents and edits survey data when inaccuracies are apparent.

We used FCC's 2002 and 2004 Cable Price surveys to identify areas where cable operators provided advanced services and also for information on price, number of channels, and other operating data necessary for our cable-satellite econometric model. Because our use of data from FCC's surveys was important in a comparative manner, rather than an absolute sense—that is, our primary concern with cable rates was the relative level of rates between cable franchises, rather than the absolute rate in a particular cable franchise—it is not important for our use that the data be precise. We conducted logic tests to identify any observations with apparent inaccuracies in the variables of interest for our work. We determined that the data were sufficiently reliable for our analysis.

¹See, GAO, *Telecommunications: Data Gathering Weaknesses in FCC's Survey of Information on Factors Underlying Cable Rate Changes*, [GAO-03-742T](#) (Washington, D.C.: May 6, 2003); *Telecommunications: Issues Related to Competition and Subscriber Rates in the Cable Television Industry*, [GAO-04-8](#) (Washington, D.C.: Oct. 24, 2003); and *Telecommunications: Subscriber Rates and Competition in the Cable Television Industry*, [GAO-04-262T](#) (Washington, D.C.: Mar. 25, 2004).

SBCA's DBS Subscriber
Counts

SBCA possesses data on the number of DBS subscribers by zip code. To respond to the objectives of this report, we sent SBCA a letter identifying the specific data elements we required. SBCA officials prepared a set of data sets consistent with our needs. We conducted logic tests on SBCA's data and identified some inconsistencies, which we discussed with SBCA officials. SBCA officials subsequently took steps to resolve these inconsistencies. Based on the revised data we received from SBCA and our subsequent tests, we determined that the data were sufficiently reliable for our analysis.

Knowledge Network's *The
Home Technology Monitor:
Spring 2004 Ownership
and Trend Report*

To obtain information on the availability of cable service and types of television service used by U.S. households, we purchased existing survey data from Knowledge Networks Statistical Research. This survey was completed with 2,375 of the estimated 5,075 eligible sampled individuals for a response rate of 47 percent; partial interviews were conducted with an additional 96 people, for a total of 2,471 individuals completing some of the survey questions. The survey was conducted between February 23 and April 25, 2004. Because we did not have information on those contacted who chose not to participate in the survey, we could not estimate the impact of the nonresponse. Our findings will be biased to the extent that the people at the 53 percent of the telephone numbers that did not yield an interview have experiences with television service or equipment that are different from the 47 percent of our sample who responded. However, distributions of selected household characteristics (including presence of children, race, and household income) for the sample and the U.S. Census estimate of households show a similar pattern.

To assess the reliability of these survey data, we reviewed documentation of survey procedures provided by Knowledge Networks and questioned knowledgeable officials about the survey process and resulting data. We determined that the data were sufficiently reliable for the purposes of this report.

Cable-Satellite Econometric Model

This appendix describes our econometric model of cable-satellite competition. In particular, we discuss (1) the specification of the model, (2) the data sources used for the model, (3) the merger of various data sources into a single data set, (4) the descriptive statistics for variables included in the model, (5) the estimation methodology and results, and (6) alternative specifications.

Specification of Econometric Model of Cable-Satellite Competition

We developed an econometric model to examine the influence of various factors, including those describing aspects of cable competition at the local level, on local DBS penetration rates. Estimating the importance of various factors on the DBS penetration rate is complicated by the possibility that the DBS penetration rate in an area may help determine, but also be determined by, in part, the local cable price in that area. One statistical method applicable in this situation is to estimate a system of structural equations in which certain variables that may be simultaneously determined are estimated jointly. In our previous reports, we estimated a four-equation structural model in which cable prices, the number of cable subscribers, the number of cable channels, and the DBS penetration rate were jointly determined.¹ We use this same general structure again, this time using the most recent information available from FCC's 2004 Cable Price Survey and contemporaneous satellite subscriber information provided by the Satellite Broadcasting and Communications Association. We made some minor modifications because of, for example, changes in the subscription video market.

We estimated the following four-equation structural model of the subscription video market:

- **DBS penetration rate in a local market** is hypothesized to be related to (1) cable prices per channel; (2) the DBS companies' provision of local stations in the franchise area; (3) the size of the television market as measured by the number of television households; (4) the age of the cable franchise; (5) the median household income of the local area; (6) cable system capacity in terms of megahertz; (7) a dummy variable for

¹See GAO, *Telecommunications: Issues Related to Competition and Subscriber Rates in the Cable Television Industry*, [GAO-04-8](#) (Washington, D.C.: Oct. 24, 2003); [GAO-03-130](#) (Washington, D.C.: Oct. 15, 2002); and *Telecommunications: The Effect of Competition from Satellite Providers on Cable Rates*, [GAO/RCED-00-164](#) (Washington, D.C.: July 18, 2000).

areas outside metropolitan areas; (8) the percentage of multiple dwelling units; (9) the angle, or elevation, at which a satellite dish must be fixed to receive a satellite signal in that area; and (10) the presence of a nonsatellite competitor. The DBS penetration rate variable is defined as the number of DBS subscribers in a franchise area expressed as a proportion of the total number of housing units in the area. As hypothesized, the DBS penetration rate is expected to depend on the prices set by the cable provider as well as on the demand, cost, and regulatory conditions in the subscription video market that directly affect DBS.

- **Cable prices** are hypothesized to be related to (1) the number of channels, (2) the number of cable subscribers, (3) the DBS penetration rate, (4) the DBS companies' provision of local stations in the franchise area, (5) the size of the television market as measured by the number of television households, (6) horizontal concentration, (7) vertical relationships, (8) the presence of a nonsatellite competitor, (9) regulation, (10) average wages, and (11) population density. The cable price variable used in the model is intended to reflect the total monthly rate charged by a cable franchise to the typical subscriber. The explanatory variables in the cable price relationship are essentially cost and market structure variables.
- **Number of cable subscribers** is hypothesized to be related to (1) cable prices per channel, (2) the DBS penetration rate, (3) the number of broadcast stations, (4) urbanization, (5) the age of the cable franchise, (6) the number of homes passed by the cable system, (7) the median household income of the local area, and (8) the presence of a nonsatellite competitor. The number of cable subscribers is defined as the number of households in a franchise area that subscribe to the most commonly purchased programming tier. This represents the demand equation for cable services, which depends on rates and other demand-related factors.
- **Number of channels** is hypothesized to be related to (1) the number of cable subscribers, (2) the DBS penetration rate, (3) the size of the television market as measured by the number of television households, (4) the median household income of the local area, (5) cable system capacity in terms of megahertz, (6) the percentage of multiple dwelling units, (7) vertical relationships, and (8) the presence of a nonsatellite competitor. The number of channels is defined as the number of channels included in the most commonly purchased programming tier.

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Cable-Satellite Econometric Model**

The number of channels can be thought of as a measure of cable programming quality and is explained by a number of factors that influence the willingness and ability of cable operators to provide high-quality service and consumers' preference for quality.

Table 1 presents the explanatory variables in the structural model on cable prices and DBS penetration rates.

Table 1: Explanatory Variables Used in Cable-Satellite Model

Explanatory variable	Definition of variable
Cable price	The monthly rate charged for the Basic Service Tier and Cable Programming Service Tier (the most commonly purchased tier).
Number of cable subscribers	The number of subscribers to the Basic Service Tier and Cable Programming Service Tier (the most commonly purchased tier).
Number of channels	The number of channels provided with the Basic Service Tier and Cable Programming Service Tier (the most commonly purchased tier).
DBS penetration rate	The fraction of housing units in a cable franchise area that have satellite service.
DBS provision of local stations	A binary variable that equals 1 if one or both DBS providers offer local broadcast stations in the cable franchise area.
Television market size	The number of television households in the market.
Horizontal concentration	A binary variable that equals 1 if the cable operator providing service in the franchise area is affiliated with a multiple system operator (MSO) that serves over 1 million subscribers nationally.
Vertical relationship	A binary variable that equals 1 if the cable operator is affiliated with an MSO that has an ownership interest in a national or regional video programming service.
Presence of nonsatellite competitor	A binary variable that equals 1 if a second wireline company provides cable service (including, for example, a broadband service provider) in the franchise area.
Average wage	The average weekly wage for telecommunications equipment installers and repairers in the metropolitan area, or state, in the case of nonmetropolitan areas, where the cable franchise is located.
Population density	The ratio of population to square miles in the franchise area.
Number of broadcast stations	The number of over-the-air broadcast stations in the television market.
Urbanization	The percentage of the county's population that is classified as urban by the Census Bureau.
Age of cable franchise	The number of years between when the cable franchise began operation and 2004.
Homes passed by cable system	The number of homes passed by the cable system that serves the franchise area, including homes outside the franchise area.
Median household income	The median household income in the franchise area.
Cable system megahertz	The capacity, measured in megahertz, of the cable system that serves the franchise area.
Percentage of multiple dwelling units	The percentage of housing units accounted for by structures with five or more housing units.
Nonmetropolitan areas	A binary variable that equals 1 if the franchise area is outside a metropolitan statistical area (MSA).

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Explanatory variable	Definition of variable
Angle (or “elevation”) of satellite dish	The angle relative to the ground that a DBS subscriber must mount the satellite dish to “see” the satellite.
Regulation	A binary variable that equals 1 if the cable franchise is subject to regulation of the rate charged for the Basic Service Tier.

Source: GAO.

Data Sources Used for the Econometric Model

We required several data elements to build the data set used to estimate this model. The following is a list of our primary data sources.

- We obtained data on cable prices and service characteristics from the 2004 Cable Price Survey that FCC conducted as part of its mandate to report annually on cable prices. FCC’s survey asked a sample of cable franchises to provide information, as of January 1, 2004, about a variety of items pertaining to cable prices, service offerings, subscribership, franchise area reach, franchise ownership, and system capacity. We used the survey to define measures of each franchise area’s cable prices, number of subscribers, and number of channels as described above. In addition, we used the survey to define variables measuring (1) system megahertz (the capacity of the cable system in megahertz), (2) homes passed by the cable system serving the franchise area and perhaps other franchises in the same area, (3) regulation—a dummy variable equal to 1 if the franchise is subject to rate regulation of its Basic Service Tier, (4) horizontal concentration—a dummy variable equal to 1 if the franchise area is affiliated with one of the largest MSOs with at least 1 million subscribers nationally, and (5) the status of nonsatellite competition—a dummy variable equal to 1 if the franchise faced competition from a second wireline company that provides cable service.
- From the Satellite Broadcasting and Communications Association, we obtained DBS subscriber counts as of January 2004 for each zip code in the United States. We used this information to calculate the number of DBS subscribers in a cable franchise area, which, when divided by the number of housing units, was used to define the DBS penetration rate.
- We used the most recent data from the Census Bureau to obtain the following demographic information for each franchise area: housing units, median household income, proportions of urban and rural populations, housing units accounted for by structures with more than

five units (multiple dwelling units), population density, and nonmetropolitan statistical areas.

- For average wage, we used May 2003 estimates for Installation, Maintenance, and Repair Occupations from the Bureau of Labor Statistics' (BLS) National Occupational Employment and Wage Estimates. We used metropolitan area data for most franchise areas, and state-level data for those franchise areas located outside of metropolitan areas.
- We used data from BIA MEDIA AccessPro™ to determine the number of broadcast television stations in each television market.
- To define the dummy variable indicator of vertical integration, we used information on the corporate affiliations of the franchise operators provided in FCC's survey. We used this information in conjunction with industrywide information on vertical relationships between cable operators and suppliers of program content gathered by FCC in its Tenth Annual Report on the status of competition in the market for delivery of video programming.
- From Nielsen Media Research, we acquired information to determine the number of television households in each designed market area (DMA), or television market, and the DMA in which each cable franchise was located.
- We used information from the two DBS companies (DIRECTV® and EchoStar) to identify DMAs in which these companies provide local stations and, if local stations are available, when the companies initiated this service. We used this to construct a measure of local station availability, as well as alternative specifications presented in the final section.
- Based on a zip code associated with each cable franchise area, we determined the necessary satellite dish elevation for each area based on information available from the Web pages of the two DBS companies.

Merging Various Data Sources into a Single Data Set

The level of observation in our model is the local cable franchise.² Many of the variables we used to estimate our model, such as each cable franchise's price, come directly from FCC's Cable Price Survey. However, we also created variables describing competitive, geographic, and economic conditions in each franchise area. For these variables, we used information from other sources. For example, we obtained median household income and the extent of multiple dwelling units from Census Bureau data, and derived the DBS penetration rate from information provided by the Satellite Broadcasting and Communications Association. Generally, these data are reported at other geographic levels, and we describe briefly the process by which we merged these different data sources.

Cable franchise areas take a variety of jurisdictional forms, such as city or town, or unnamed, unincorporated area. As a consequence, they do not correspond in many cases to well-recognized geographical units, such as Census places, for which other data are readily available. Our approach to identifying the geographic extent of each franchise area and relating information processed at different geographic levels to each franchise area is similar to that we have used and described in detail in our previous reports. In general, we used information in FCC's survey identifying franchise community name and type (such as city or town) to match to Census geographic identification codes for particular places or county subdivisions that do correspond to Census geography. In particular, we used 2000 Census information on the number of housing units in these jurisdictions as the basis for our measure of DBS penetration. For other franchises, however, the link to Census records was not as direct. For franchises in unincorporated unnamed areas, for example, and those whose franchise areas represent a section of the associated community (which occurs in some large cities³), we acquired additional information on the geographic boundaries of the franchise areas.⁴

²We define a cable franchise in terms of its FCC assigned Community Unit Identification (CUID) number.

³Many large cities, such as New York City, Los Angeles, and Chicago, have multiple cable franchise areas.

⁴For those jurisdictions for which there were multiple franchises, including counties with franchises in unincorporated unnamed areas, we attempted to define more precise geographical boundaries for each franchise. Specifically, we contacted local government offices responsible for cable franchise oversight and received maps or other descriptive information linking the specific franchise areas to zip codes, census tracts, local government districts, or some other boundary information.

The satellite subscriber information we obtained was organized by zip code. In order to link these subscriber counts to franchise area geographies, we determined the zip code or zip codes associated with each franchise. Because zip codes often do not share boundaries with other geographies, one zip code can be associated with more than one cable franchise area. Also, many franchises, particularly larger ones, span many zip codes. Therefore, we needed to identify the zip code or codes in each franchise area as well as the degree to which each of those zip codes is contained in each franchise area to calculate the degree of satellite penetration for each franchise area. We accomplished this by using software designed to relate various levels of census geography to one another.⁵ For most franchise areas—that is, those that correspond to census places, county subdivisions, or entire counties—we were able to use this software to relate census places, county subdivisions, or other census geographies directly to the zip codes that corresponded to those areas and to calculate the share of each zip code’s population according to the 2000 Census that was contained in that area. We used these population shares to allocate shares of each zip code’s total DBS subscribers to the relevant franchise area, and then summed the resulting subscribers across all zip codes in that franchise area.⁶ We defined the penetration by dividing this subscriber total by an estimate of the housing units in that franchise area in January 2004.⁷

⁵In particular, we used the MABLE/Geocorr correspondence engine (<http://mcdc2.missouri.edu/websas/geocorr2k.html>). MABLE is an acronym for Master Area Block Level Equivalency file.

⁶As an illustration, assume we have a cable franchise area in the town of Anytown, which the MABLE software identifies as served by zip codes 12345 and 12346. Assume further that zip code 12345 had a population of 10,000 people in 2000, of which 8,000 were in Anytown proper and 2,000 were in the surrounding unincorporated area, and zip code 12346 had a population of 12,000 people, of which 6,000 were in Anytown. In this case, 80 percent of the 12345 zip code and 50 percent of the 12346 populations are associated with Anytown, so that our approach would assign 80 percent of the satellite subscribers in zip code 12345 and 50 percent of those in 12346 to the cable franchise in the town of Anytown. Because we defined the DBS penetration rate as the number of subscribers divided by the number of housing units, our approach would divide this estimate of the number of DBS subscribers in Anytown by the number of housing units reported in the 2000 Census for the town of Anytown.

⁷We used county-level housing unit projections made by the Census Bureau to adjust the 2000 housing unit counts to January 2004. This adjustment process assumes that growth was uniform within the boundaries of each county.

As part of the process of identifying the zip codes associated with each franchise area, we identified a key zip code that we used for linking other data items. We used Census data organized at the zip code level to assign demographic data, such as income and the extent of multiple dwelling units, to each franchise area. We also used this key zip code to attach information concerning the proper satellite dish elevation.

We assigned other information to each franchise on the basis of the franchise’s county, state, or metropolitan area. We assigned wage data from BLS at the metropolitan or state level and we assigned nonmetropolitan status, percentage of urban population, and the Nielsen television market of each franchise at the county level.⁸ Information on the provision of local stations by DBS companies, which occurs at the television market level, was then assigned to each franchise.

Descriptive Statistics for Variables Included in the Econometric Model

Table 2 provides basic statistical information on all of the variables included in the cable-satellite competition model. We calculated these statistics using 624 observations in our data set. We excluded those franchises sampled by FCC that were municipally operated or that competed directly with municipally operated franchises because we believe that these cable franchises are likely to be operated differently from the majority of other franchises.

Table 2: Descriptive Statistics for Variables Used in Cable-Satellite Model

Variable	Mean	Standard deviation	Minimum value	Maximum value
Cable price	40.25	5.10	16.99	53.90
Number of cable subscribers	27,497.7	50,744.9	35.0	401,174.0
Number of channels	70.7	11.5	14.0	120.0
Number of local broadcast stations	15.6	6.6	3.0	34.0
DBS penetration rate	16.2	10.6	1.1	77.2
Urbanization	78.6	25.2	0.0	100.0
Age of cable franchise	27.7	10.2	2.0	53.0

⁸In the Nielsen data, some counties are split between different television markets. In cases where a franchise’s county was not uniquely placed in one television market, we used additional information on zip codes to assign the franchise to a television market.

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Cable-Satellite Econometric Model**

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Variable	Mean	Standard deviation	Minimum value	Maximum value
Homes passed by cable system	233,493.8	265,476.7	190.0	1,368,050.0
Median household income	45.6	16.3	18.7	146.8
Average wage	704.1	66.22	475.19	852.7
Cable system megahertz	730.6	127.2	212.0	870.0
Regulation	0.36	0.48	0.00	1.00
Horizontal concentration	0.83	0.38	0.00	1.00
Vertical relationship	0.64	0.48	0.00	1.00
Percentage of multiple dwelling units	16.04	13.96	0.00	98.12
Presence of nonsatellite competitor	0.22	0.41	0.00	1.00
Television market size	1,685.4	1,842.5	57.0	7,301.0
Nonmetropolitan area	0.21	0.40	0.00	1.00
DBS provision of local stations	0.85	0.36	0.00	1.00
Population density	2,949.6	4,891.9	16.8	66,940.0
Angle (or "elevation") of satellite dish	40.1	6.5	27.6	57.1

Source: GAO.

Estimation Methodology and Results

We employed the Three-Stage Least Squares (3SLS) method to estimate our model.⁹ Table 3 includes the estimation results for each of the four structural equations. All of the variables, except dummy variables,¹⁰ are expressed in natural logarithmic form.¹¹ This means that coefficients can be interpreted as “elasticities”—the percentage change in the value of the dependent variable associated with a 1 percent change in the value of an independent, or explanatory,

⁹We preferred 3SLS to Two-Stage Least Squares (2SLS) because 3SLS accounts for the contemporaneous relationships among cable rates, cable subscribers, cable channels, and DBS penetration by using all available information. Also, we assumed that price per channel in the subscriber equation is exogenous because cable providers simultaneously decide how many channels to provide and what to charge for a package of channels, rather than deciding how much to charge for each channel.

¹⁰A dummy variable takes a value of 1 if a certain characteristic is present and a value of 0 otherwise.

¹¹The dummy variables in the model include the following: horizontal concentration of cable systems, vertical relationship, regulation, presence of nonsatellite competitor, DBS provision of local stations, and nonmetropolitan area. Also, because the natural log of 0 is undefined, we added 1 to the observed value of any continuous variable that can take the value of 0.

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variable. The coefficients on the dummy variables are elasticities in decimal form.

Table 3: Three-Stage Least Squares Model Results

Variable	Cable prices equation	Cable subscribers equation	Cable channels equation	DBS penetration equation
Cable price per channel		-2.6260 [0.0001] ^a		0.4582 [0.0002] ^a
Number of channels	0.3955 [0.0001] ^a			
Number of cable subscribers	-0.0131 [0.1692]		0.0340 [0.0001] ^a	
DBS penetration	-0.0476 [0.0152] ^b	-1.4420 [0.0001] ^a	0.0419 [0.0586] ^c	
DBS provision of local stations	0.0139 [0.4317]			0.1131 [0.0770] ^c
Regulation	0.0157 [0.2234]			
Number of broadcast stations		0.2838 [0.0366] ^b		
Median household income		-0.3974 [0.0358] ^b	0.0673 [0.0007] ^a	0.2006 [0.0026] ^a
Horizontal concentration	0.0133 [0.4591]			
Vertical relationship	-0.0414 [0.0035] ^a		0.0163 [0.2815]	
Presence of nonsatellite competitor	-0.1694 [0.0001] ^a	-1.4280 [0.0001] ^a	0.0808 [0.0001] ^a	-0.4607 [0.0001] ^a
Nonmetropolitan area				0.3460 [0.0001] ^a
Urbanization		0.4624 [0.0001] ^a		
Percentage of multiple dwelling units			0.0032 [0.7428]	-0.2485 [0.0001] ^a
Age of cable franchise		0.2738 [0.0236] ^b		-0.1332 [0.0011] ^a
Homes passed by cable system		0.2546 [0.0001] ^a		
Cable system megahertz			0.4654 [0.0001] ^a	-0.2406 [0.0118] ^b
Television market size	-0.0067 [0.3588]		0.0267 [0.0001] ^a	0.0848 [0.0003] ^a

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Variable	Cable prices equation	Cable subscribers equation	Cable channels equation	DBS penetration equation
Population density	0.0015 [0.8090]			
Average wage	0.0609 [0.3791]			
Angle (or "elevation") of satellite dish				1.0697 [0.0001] ^a
Intercept	1.9190 [0.0001] ^a	9.1412 [0.0001] ^a	-0.1648 [0.5435]	-1.2538 [0.2452]
Sample size	624	624	624	624

Source: GAO.

Notes: System-weighted R-square: 0.49.

P-values are in square brackets.

^aSignificant at the 1 percent level.

^bSignificant at the 5 percent level.

^cSignificant at the 10 percent level.

We found that several factors related to the geographical conditions influence the DBS penetration rate. Specifically, as shown in table 3, DBS penetration rates are likely to be significantly higher in nonmetropolitan areas. This could be associated with the historical development of satellite service, which had been marketed for many years in smaller and more rural areas. Additionally, the DBS penetration rate is higher in areas that require a relatively higher angle or elevation at which the satellite dish is mounted and is lower in areas where there are more multiple dwelling units. These two factors can be associated with the need of DBS satellite dishes to "see" the satellite: A dish aimed more toward the horizon (as opposed to aimed higher in the sky) is more likely to be blocked by a building or foliage, and people in multiple dwelling units often have fewer available locations to mount a satellite dish.

Additionally, we found that several factors related to competitive conditions influence the DBS penetration rate. As shown in table 3, our model results indicate that in cable franchise areas where local broadcast stations are available from one or both DBS providers, the DBS penetration rate is approximately 12 percent higher than in areas where local stations

are not available via satellite.¹² This finding suggests that in areas where local stations are available from one or both DBS providers, consumers are more likely to subscribe to DBS service and, therefore, DBS appears to be more competitive with cable than in areas where local stations are not available from a DBS provider.

We did not find that DBS companies' provision of local broadcast stations is associated with lower cable prices. In table 3, the estimate is, in fact, positive, although not statistically significant, and we therefore cannot reject the hypothesis that provision of local broadcast stations has no impact on cable prices. However, we found that cable prices were approximately 16 percent lower in areas where a second cable company—known as an overbuilder—provides service. Finally, cable prices are higher in areas where the cable company provides more channels, indicating that consumers are generally willing to pay for additional channels and that providing additional channels raises a cable company's costs. Additionally, we found that DBS penetration rates are lower in cable franchise areas where a second wire-based competitor is present; in these areas, the DBS penetration rate is 37 percent lower compared with similar areas where a second wire-based competitor is not present.

Alternative Specifications

We considered alternative specifications under which we expanded the definition of local broadcast stations to account for (1) whether one or both DBS companies offer local stations and (2) the length of time that DBS companies have provided local stations. To conduct this analysis, we included several additional variables: "Both DBS companies provide" equals 1 if both DBS companies offer local stations in the cable franchise area, "One DBS company provides" equals 1 if only one DBS company offers local stations, "Long-term" equals 1 if either or both DBS companies have offered local stations in the cable franchise area for more than 3 years as of January 2004, "Short-term" equals 1 if local stations have been available for less than 3 years, "Both long-term" equals 1 if both DBS companies have offered local stations in the cable franchise area for more

¹²This magnitude is less than we found previously; using 2001 data, we found that the DBS penetration rate was about 40 percent higher in cable franchises in which local stations were offered by both DBS companies. The somewhat smaller impact of local stations could be because the DBS companies have introduced this service into many more areas, including some smaller television markets.

than 3 years as of January 2004, and “Both otherwise” equals 1 if local stations have otherwise been available from both DBS companies.

We report the results of these alternative specifications only for the DBS penetration equation because we are primarily interested in their affects on DBS penetration and we found little impact on the other equations in the model. We present the results for four different specifications in table 4. In general, there is evidence that the longer that local stations have been available in a local area, the larger will be the increase in the local DBS penetration rate, and that the increase in the local DBS penetration rate is greater in those areas in which both DBS companies provide local stations.

Table 4: Alternative Specification Results

Variable	DBS penetration equation: main specification (from table 3)	DBS penetration equation: both or one provided	DBS penetration equation: long term and short term	DBS penetration equation: duration and number of providers
Cable price per channel	0.4582 [0.0002] ^a	0.4646 [0.0002] ^a	0.4690 [0.0002] ^a	0.5103 [0.0001] ^a
DBS provision of local stations	0.1131 [0.0770] ^c			
Both DBS companies provide		0.1562 [0.0409] ^b		
One DBS company provides		0.0862 [0.2127]		0.1106 [0.1135]
Long-term (greater than 3 years)			0.2207 [0.0096] ^a	
Short-term (less than 3 years)			0.0929 [0.1493]	
Both long-term				0.2852 [0.0030] ^a
Both otherwise				0.1347 [0.0793] ^c
Median household income	0.2006 [0.0026] ^a	0.1977 [0.0031] ^a	0.1919 [0.0040] ^a	0.1921 [0.0039] ^a
Presence of nonsatellite competitor	-0.4607 [0.0001] ^a	-0.4646 [0.0001] ^a	-0.4703 [0.0001] ^a	-0.4615 [0.0001] ^a
Nonmetropolitan areas	0.3460 [0.0001] ^a	0.3476 [0.0001] ^a	0.3417 [0.0001] ^a	0.3417 [0.0001] ^a
Percentage of multiple dwelling units	-0.2485 [0.0001] ^a	-0.2469 [0.0001] ^a	-0.2474 [0.0001] ^a	-0.2448 [0.0001] ^a

**Appendix III
Cable-Satellite Econometric Model**

(Continued From Previous Page)

Variable	DBS penetration equation: main specification (from table 3)	DBS penetration equation: both or one provided	DBS penetration equation: long term and short term	DBS penetration equation: duration and number of providers
Age of cable franchise	-0.1332 [0.0011] ^a	-0.1319 [0.0013] ^a	-0.1296 [0.0015] ^a	-0.1322 [0.0012] ^a
Cable system megahertz	-0.2406 [0.0118] ^b	-0.2346 [0.0142] ^b	-0.2341 [0.0140] ^b	-0.2240 [0.0189] ^b
Television market size	0.0848 [0.0003] ^a	0.0687 [0.0138] ^b	0.0445 [0.1513]	0.0234 [0.4981]
Angle (or "elevation") of satellite dish	1.0697 [0.0001] ^a	1.0514 [0.0001] ^a	1.0202 [0.0001] ^a	1.0173 [0.0001] ^a
Intercept	-1.2538 [0.2452]	-1.114 [0.3054]	-0.8147 [0.4559]	-0.7400 [0.5003]
Sample size	624	624	624	624

Source: GAO.

Notes: P-values are in square brackets.

^aSignificant at the 1 percent level.

^bSignificant at the 5 percent level.

^cSignificant at the 10 percent level.

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